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REVISED NORMATIVE STANDARDS OF PERFORMANCE OF  
MEN ON A QUANTITATIVE ATAXIA TEST BATTERY

Alfred R. Fregly, Margaret J. Smith, and Ashton Graybiel



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## SUMMARY PAGE

### THE PROBLEM

To revise normative standards of performance of men, ages 16-60 years, on a quantitative ataxia test battery in terms of new chronological age groupings based on a sample of 1055 normal men.

### FINDINGS

Highly significant relationships in ataxia test battery scores were found with age, spanning 16 to 60 years of age. All subtests of the battery, except Walk On Floor Eyes Closed (WOFEC) test, were very nearly similar in sensitivity to aging influences, implying a reliably unitary sensitivity of the battery to aging influences on the complex postural equilibrium functions sampled by it.

Present findings tentatively suggest that the negative aging influences become apparent several years earlier than reported previously (within the age range of 31-40 years rather than 43-50 years). The progressive nature of this aging influence along the life span sampled is similar to that previously reported on women.

The new normative standards presented should allow more precise laboratory and clinical applications of the test battery which has proved to be useful particularly in the vestibular physiological and neuro-otological assessment of postural equilibrium-disequilibrium, including spontaneous and induced vestibular ataxia. The test battery has other clinical and/or research applications.

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| <p>Revised normative standards of performance of men, ages 16-60 years, on a quantitative ataxia test battery in terms of new chronological age groupings based on a sample of 1055 normal men are presented. Five age groups--16-30, 31-40, 41-45, 46-50, and 51-60 years--were found to be required to reduce the correlation with age to a nonsignificant level. All subtests of the battery, except Walk On Floor Eyes Closed (WOFEC), were very nearly similar in sensitivity to aging influences, implying a reliably unitary sensitivity of the battery to aging influences on the complex postural equilibrium functions sampled by it. Present findings tentatively suggest that the negative aging influences become apparent several years earlier than reported previously (within the age range of 31-40 years rather than 43-50 years). The progressive nature of this aging influence along the life span sampled is similar to that previously reported on women. The new normative standards should allow more precise laboratory and clinical applications of the test battery which has proved to be useful particularly in the vestibular physiological and neuro-otological assessment of postural equilibrium-disequilibrium, including spontaneous and induced vestibular ataxia. The test battery has other clinical and/or research applications.</p> |  |                                    |

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|                          | ROLE   | WT | ROLE   | WT | ROLE   | WT |
| Ataxia                   |        |    |        |    |        |    |
| Chronological aging      |        |    |        |    |        |    |
| Neuro-otological testing |        |    |        |    |        |    |
| Normative standards      |        |    |        |    |        |    |
| Performance skills       |        |    |        |    |        |    |
| Postural equilibrium     |        |    |        |    |        |    |
| Postural disequilibrium  |        |    |        |    |        |    |
| Quantitative tests       |        |    |        |    |        |    |
| Vestibular ataxia        |        |    |        |    |        |    |
| Vestibular physiology    |        |    |        |    |        |    |

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## INTRODUCTION

Several years ago age-influenced normative standards of performance on a new quantitative ataxia test battery designed initially for assessment of vestibular ataxia (1,7)\* were published (2,7). To control for the observed negative influence of chronological aging on scores, the normative standards were presented in relation to several chronological age groupings. Meanwhile, many additional individuals--almost entirely men--were tested, and new indications of aging influences on test scores came to light. Accordingly, normative standards were revised in terms of new chronological age groupings, incorporating the additional samples of normal men tested and new 5th percentile and below cut-off scores relative to an arbitrary definition of frank ataxia (3,4). This up-dated information is presented and discussed to allow more precise laboratory and clinical applications of the test battery.

## PROCEDURE

### SUBJECTS

The sample of 1055 normal men, 16 to 60 years of age, included all those physically fit† who had been tested since standardization of the short version of the "rail battery" and the "floor battery" of ataxia tests (1,4,7). Occupational groups included experienced and student military and civilian aviators, Army and Navy enlisted and civilian college student volunteer research subjects; Navy deep-sea divers; and miscellaneous active and retired military and civilian scientific, medical, engineering, aviation, and technical personnel.

### METHOD

Because detailed administration and scoring procedures have been published previously (1,2,4,7), these tests are described only briefly below. All tests were undertaken while subjects wore hard-soled shoes and were in the stringent position of arms folded against chest, feet aligned heel-to-toe (tandemly), with the exception of the Stand One Leg Eyes Closed tests, and body erect or nearly erect. Administered in the following order, they consisted of the:

1. Sharpened Romberg (SR): standing on the floor with eyes closed for 60 seconds. Maximum score obtainable: 240 seconds.
2. Walk Eyes Open (Walk E/O): walking 5 steps per trial on a 3/4-inch-wide by 8-foot-long rail. Maximum score obtainable: 15 steps.
3. Stand Eyes Open (Stand E/O): standing on the 3/4-inch-wide rail for a maximum of 60 seconds per trial. Maximum score obtainable: 180 seconds.

\* The items of the battery are also known as tests of postural equilibrium-disequilibrium (7).

† All had undergone a comprehensive medical and audiological evaluation. The very great majority also had benefit of a comprehensive vestibular evaluation.

4. Stand Eyes Closed (Stand E/C): standing on a 2-1/4-inch-wide by 30-inch-long rail for a maximum of 60 seconds per trial. Maximum score obtainable: 180 seconds.
5. and 6. Stand One Leg Eyes Closed (SOLEC-R and SOLEC-L): standing stationary on the floor on each leg for a maximum of 30 seconds on any trial. Maximum score obtainable: 150 seconds on each leg.
7. Walk On Floor Eyes Closed (WOFEC): walking in the stringent position described above for a maximum of 10 steps per trial. Maximum score obtainable: 30 steps.

This battery of ataxia tests evolved in stages. Whereas all subjects undertook the "rail battery" and the SR test, as noted above, a smaller number also undertook the SOLEC tests (N = 749), and fewer still also undertook the WOFEC (N = 287).

## RESULTS

### CHRONOLOGICAL AGE INFLUENCES ON ATAXIA TEST BATTERY SCORES

To control for the negative influences of chronological aging on performance it was necessary to demonstrate a nonsignificant correlation between chronological age and scores on each of the test battery items within each of several age groupings. Five age groups were found to be required to accomplish this end as shown in Table I. The mean ataxia test scores within each new chronological grouping are plotted in Figure 1\*. It may be seen in Table I that in the total group of subjects tested (16-60 year olds), all correlations between chronological age and subtest scores were highly significant, whereas none of the consistently lower correlations within the five subgroups were statistically significant.

### REVISED ATAXIA TEST BATTERY NORMATIVE STANDARDS

Mean ataxia test battery subtest scores and standard deviations, and the raw scores and their percentile equivalents for each of the five new chronological age groupings are shown in Tables II to VII. Included in each table are the mean ages and standard deviations. For the convenience of users of the ataxia test battery, the recently published WOFEC test norms (4) are reproduced in form similar to the above in Table VIII. Also for convenience sake, all scores arbitrarily defined as "ataxic" (3,4), i.e., all 5th percentile and below cut-off scores (4th percentile and below for WOFEC) on each ataxia test battery item for each of the five chronological age groupings, are set off by a line between the 10th and 5th percentile in Tables II to VII.

-----  
 \*WOFEC scores by ages are not included because of their very low and not statistically significant correlation ( $r = -.06$ ) with age (17-61 year old men) (4).

It should be emphasized, as reported previously (3,4), that, whereas a raw score having a 5th percentile, or below, equivalent has been defined as an ataxic test score, an individual is considered by us to be frankly ataxic (4) only when scores on all items of the battery performed with eyes closed (Stand E/C, SR, SOLEC-R and SOLEC-L, and WOFE) fall at or below the 5th percentile level (4th percentile for WOFE indicated by dotted line in Table VIII\*), and then only after "testing the limits"† (4).

## DISCUSSION

Previously published normative standards of performance on all subtests of the "rail battery" (7) and on all subtests (except WOFE) of the "floor battery" (2) were based on the following chronological age groupings: 17-42, 43-50, and 51-53 years. The new chronological age groupings on which the revised normative standards are based tentatively suggest that aging<sup>+</sup> negatively influences ataxia test battery performance skills several years earlier than previously reported (2,7); i.e., within the 30-40 rather than 43-50 year age range.

Noteworthy is the finding that amidst great individual differences in the performance scores of the men tested (Tables II-VII) as well as amidst differences in the nature of the complex performance skills sampled by the varied subtests, the magnitude of the negative influences of aging observed on all subtest (except WOFE) performance scores was very nearly similar (Figure 1). This result implies a reliably unitary sensitivity of the ataxia test battery to aging influences on the complex postural equilibrium functions sampled by it. However, the ultimate reliability of all chronological age group differences in performance scores on this ataxia battery awaits testing of additional samples of comparable individuals (particularly in the 51-60 age group).

A revision of normative standards of ataxia test battery performance scores of samples of women is needed also, particularly for clinical purposes, and awaits availability of larger samples of testees who are comparable to the samples of men tested in terms of medical and physical status. Meanwhile, present revised normative standards based on new chronological age groupings of the maximum number of normal

\* A perfect score of 30 steps was obtained by 96 percent of the standardization group and, therefore, has a 100th-5th percentile equivalent (4).

† This refers to retesting an individual to insure the reliability of 5th percentile or below scores obtained during initial testing.

+ A determination of expected medical and other health-related correlates of aging by data analysis of carefully evaluated variables would undoubtedly throw desirable light on the nature of the observed group differences in terms other than aging per se; e.g., in terms of "physiological aging." Preliminary efforts in this direction have begun (5,6).

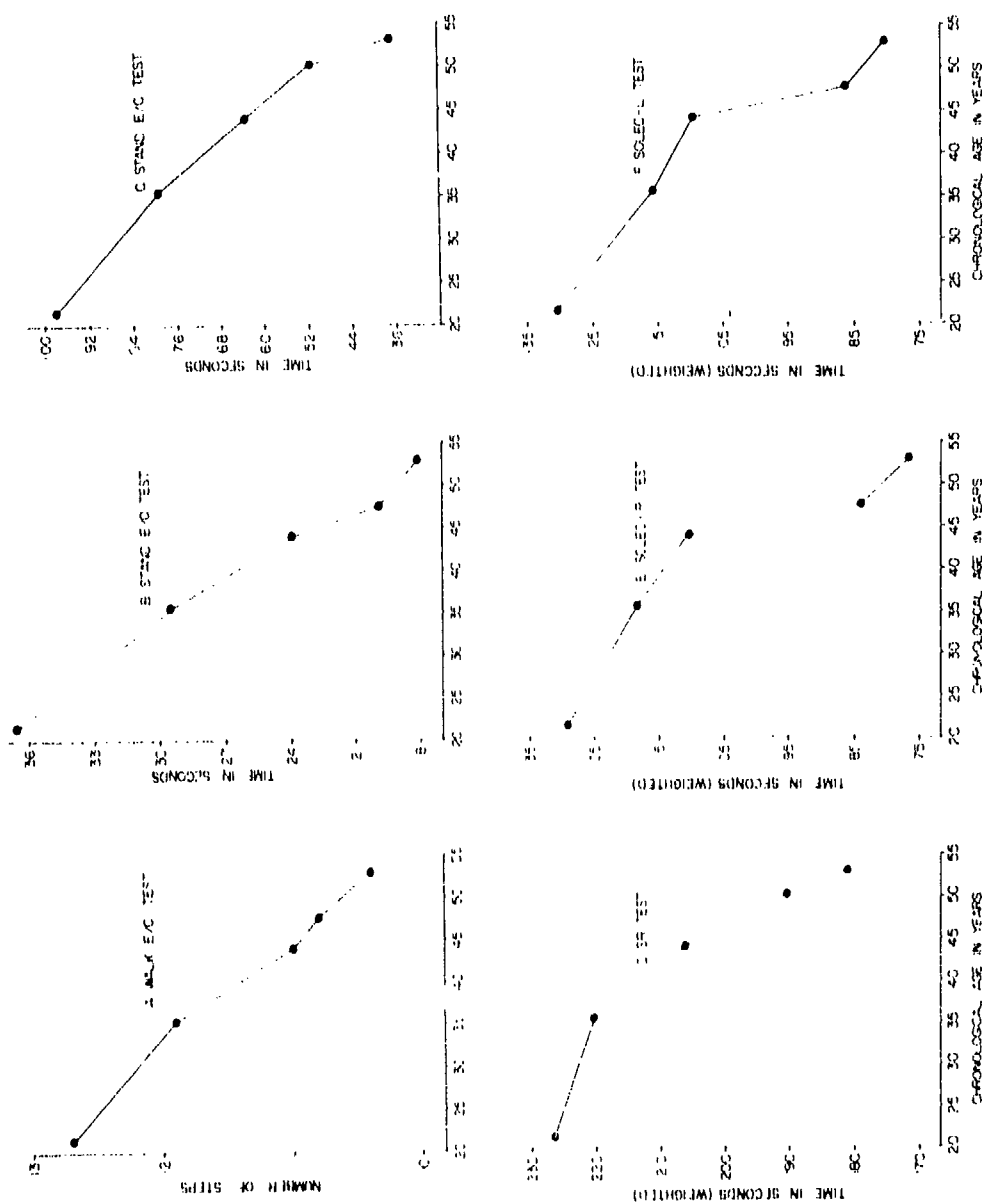


Figure 1

Chronological aging influences on ataxia test battery performance scores. A) Walking heel-to-toe with eyes open on a 3/4-inch-wide, 8-foot-long rail. B) Standing heel-to-toe with eyes open on the 3/4-inch-wide rail. C) Standing heel-to-toe with eyes closed on a 2-1/4-inch-wide, 30-inch-long rail. D) Sharpened Romberg: standing heel-to-toe on the floor with eyes closed. E-F) Stand One Leg Eyes Closed-Right and -Left on the floor.

men tested to date at this laboratory, which are now more nearly similar to the chronological age groupings employed for women--ages 18-29, 30-49, and 50-59 (2,7), should allow greater comparability of the scores of men with those of women, as well as generally more precise application of the test battery in both laboratory and clinical situations. It has proved to be particularly useful in vestibular physiological and neuro-otological assessment of postural equilibrium-disequilibrium, including spontaneous and induced vestibular ataxia (1-4,7). Clinical and/or research applications of the battery in other areas, such as medicine, physiology, pharmacology, gerontology, audiology, and psychology, are recommended.

Table I

Correlation of Ataxia Test Battery Scores with Chronological Ages of Normal Men

| Ataxia<br>Test<br>Battery | Ages 16-60 yr |       | Ages 16-30 yr |      | Ages 31-40 yr |      | Ages 41-45 yr |      | Ages 46-50 yr |      | Ages 51-60 yr |      |
|---------------------------|---------------|-------|---------------|------|---------------|------|---------------|------|---------------|------|---------------|------|
|                           | N             | r     | N             | r    | N             | r    | N             | r    | N             | r    | N             | r    |
| SR                        | 1055          | .297* | 547           | .031 | 100           | .076 | 125           | .041 | 241           | .044 | 42            | .024 |
| Walk E O                  | 1055          | .300* | 547           | .087 | 100           | .172 | 125           | .078 | 241           | .047 | 42            | .085 |
| Stand E O                 | 1055          | .266* | 547           | .058 | 100           | .186 | 125           | .080 | 241           | .018 | 42            | .014 |
| Stand E C                 | 1055          | .363* | 547           | .098 | 100           | .149 | 125           | .168 | 241           | .082 | 42            | .088 |
| SOLEC-R                   | 749           | .413* | 488           | .061 | 85            | .126 | 36            | .287 | 105           | .029 | 35            | .168 |
| SOLEC-L                   | 749           | .408* | 488           | .039 | 85            | .061 | 36            | .098 | 105           | .100 | 35            | .159 |

\*  $p < .001$

Table II

Walk E/O Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile               | Age Categories |             |             |             |             |
|--------------------------|----------------|-------------|-------------|-------------|-------------|
|                          | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                     | 15             | 15          | 15          | 15          | 15          |
| 95th                     | --             | --          | --          | --          | --          |
| 90th                     | --             | --          | --          | --          | 14          |
| 85th                     | --             | --          | 14          | 14          | --          |
| 80th                     | --             | --          | 13          | 13          | 13          |
| 75th                     | --             | 14          | --          | --          | --          |
| 70th                     | --             | --          | --          | --          | 12          |
| 65th                     | 14             | --          | 12          | --          | 11          |
| 60th                     | --             | 13          | --          | 12          | --          |
| 55th                     | --             | --          | --          | --          | 10          |
| 50th                     | 13             | --          | 11          | 11          | --          |
| 45th                     | --             | 12          | --          | --          | --          |
| 40th                     | --             | --          | 10          | 10          | --          |
| 35th                     | 12             | 11          | --          | --          | 9           |
| 30th                     | --             | 10          | --          | 9           | --          |
| 25th                     | 11             | --          | 9           | --          | 8           |
| 20th                     | --             | --          | --          | 8           | --          |
| 15th                     | 10             | 9           | 8           | 7           | 7           |
| 10th                     | 9              | --          | 7           | --          | --          |
| 5th                      | 8              | 6           | 6           | 5           | --          |
| 4th                      | 7              | --          | --          | --          | --          |
| 3rd                      | --             | --          | --          | --          | --          |
| 2nd                      | --             | 4           | 5           | 4           | 4           |
| 1st                      | 6              | --          | --          | --          | --          |
| Age N                    | 547            | 100         | 125         | 241         | 42          |
| Mean                     | 21.43          | 35.52       | 44.00       | 47.65       | 52.98       |
| S.D.                     | 3.24           | 3.01        | 1.12        | 1.36        | 2.01        |
| Score (Maximum 15 steps) |                |             |             |             |             |
| Mean                     | 12.69          | 11.89       | 11.00       | 10.83       | 10.38       |
| S.D.                     | 2.42           | 2.82        | 2.66        | 2.99        | 2.71        |

Table III

Stand E/O Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile                  | Age Categories |             |             |             |             |
|-----------------------------|----------------|-------------|-------------|-------------|-------------|
|                             | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                        | 166            | 173         | 107         | 76          | 41          |
| 98th                        | 148            | 143         | 100         | 68          | 39          |
| 97th                        | 130            | 113         | 79          | 55          | 38          |
| 96th                        | 118            | 93          | 73          | 49          | 37          |
| 95th                        | 105            | 78          | 67          | 43          | 36          |
| 90th                        | 72             | 63          | 45          | 35          | 28          |
| 85th                        | 53             | 43          | 37          | 27          | 26          |
| 80th                        | 47             | 37          | 32          | 24          | 25          |
| 75th                        | 42             | 32          | 29          | 22          | 23          |
| 70th                        | 38             | 29          | 26          | 21          | 22          |
| 65th                        | 34             | 27          | 24          | 20          | 21          |
| 60th                        | 31             | 25          | 22          | 19          | 20          |
| 55th                        | 29             | 23          | 20          | 18          | 19          |
| 50th                        | 27             | 21          | 18          | 17          | 18          |
| 45th                        | 26             | 19          | 17          | 16          | 17          |
| 40th                        | 24             | 18          | 16          | 15          | 16          |
| 35th                        | 22             | 17          | 14          | 14          | 15          |
| 30th                        | 20             | 16          | 13          | 13          | 13          |
| 25th                        | 19             | 15          | 12          | 12          | 12          |
| 20th                        | 17             | 13          | 11          | 11          | 11          |
| 15th                        | 16             | 12          | 10          | --          | 10          |
| 10th                        | 14             | 10          | 9           | 10          | 9           |
| 5th                         | 12             | 9           | 8           | 9           | 8           |
| 4th                         | 11             | 8           | --          | --          | --          |
| 3rd                         | 10             | --          | 7           | 8           | --          |
| 2nd                         | 9              | 6           | 5           | --          | 7           |
| 1st                         | --             | 5           | 4           | --          | 5           |
| Age N                       | 547            | 100         | 125         | 241         | 42          |
| Mean                        | 21.43          | 35.52       | 44.00       | 47.65       | 52.96       |
| S.D.                        | 3.24           | 3.01        | 1.12        | 1.36        | 2.01        |
| Score (Maximum 180 seconds) |                |             |             |             |             |
| Mean                        | 36.35          | 29.50       | 23.88       | 19.90       | 18.12       |
| S.D.                        | 30.24          | 23.73       | 19.47       | 14.66       | 7.98        |

Table IV

Stand E/C Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile                  | Age Categories |             |             |             |             |
|-----------------------------|----------------|-------------|-------------|-------------|-------------|
|                             | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                        | 180            | 180         | 180         | 180         | 121         |
| 98th                        | --             | --          | --          | --          | 119         |
| 97th                        | --             | --          | --          | --          | 102         |
| 96th                        | --             | --          | 179         | 179         | 101         |
| 95th                        | --             | --          | --          | 165         | 100         |
| 90th                        | --             | 179         | 152         | 135         | 82          |
| 85th                        | 178            | 163         | 131         | 93          | 75          |
| 80th                        | 163            | 148         | 120         | 75          | 51          |
| 75th                        | 150            | 127         | 97          | 65          | 44          |
| 70th                        | 140            | 118         | 72          | 54          | 37          |
| 65th                        | 127            | 100         | 62          | 48          | 35          |
| 60th                        | 115            | 78          | 56          | 43          | 33          |
| 55th                        | 106            | 63          | 47          | 39          | 31          |
| 50th                        | 92             | 56          | 43          | 34          | 30          |
| 45th                        | 78             | 49          | 37          | 29          | 28          |
| 40th                        | 70             | 45          | 34          | 28          | 26          |
| 35th                        | 62             | 36          | 30          | 25          | 25          |
| 30th                        | 55             | 32          | 27          | 23          | 23          |
| 25th                        | 48             | 29          | 24          | 21          | 21          |
| 20th                        | 43             | 26          | 21          | 20          | 19          |
| 15th                        | 35             | 23          | 19          | 18          | 17          |
| 10th                        | 30             | 20          | 17          | 16          | 14          |
| 5th                         | 22             | 16          | 13          | 14          | 11          |
| 4th                         | 20             | 15          | 12          | 13          | 10          |
| 3rd                         | 18             | 14          | 11          | --          | --          |
| 2nd                         | 16             | --          | 10          | 11          | 9           |
| 1st                         | 14             | --          | 9           | 10          | --          |
| Age N                       | 547            | 100         | 125         | 241         | 42          |
| Mean                        | 21.43          | 35.52       | 44.00       | 47.65       | 52.98       |
| S.D.                        | 3.24           | 3.01        | 1.12        | 1.36        | 2.01        |
| Score (Maximum 180 seconds) |                |             |             |             |             |
| Mean                        | 98.01          | 79.29       | 63.57       | 51.37       | 37.50       |
| S.D.                        | 55.32          | 58.03       | 51.89       | 44.84       | 26.86       |

Table V

SR Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile                  | Age Categories |             |             |             |             |
|-----------------------------|----------------|-------------|-------------|-------------|-------------|
|                             | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                        | 240            | 240         | 240         | 240         | 240         |
| 95th                        | --             | --          | --          | --          | --          |
| 90th                        | --             | --          | --          | --          | --          |
| 85th                        | --             | --          | --          | --          | --          |
| 80th                        | --             | --          | --          | --          | --          |
| 75th                        | --             | --          | --          | --          | --          |
| 70th                        | --             | --          | --          | --          | 239         |
| 65th                        | --             | --          | --          | --          | --          |
| 60th                        | --             | --          | --          | 239         | 238         |
| 55th                        | --             | --          | --          | --          | 223         |
| 50th                        | --             | 239         | 239         | 238         | 208         |
| 45th                        | --             | --          | --          | 211         | 198         |
| 40th                        | 239            | --          | 238         | 195         | 192         |
| 35th                        | --             | 238         | --          | 187         | 186         |
| 30th                        | --             | --          | 207         | 183         | 146         |
| 25th                        | 238            | 221         | 191         | 157         | 134         |
| 20th                        | 228            | 212         | 183         | 143         | 105         |
| 15th                        | 202            | 205         | 135         | 106         | 76          |
| 10th                        | 189            | 158         | 92          | 68          | 69          |
| 5th                         | 161            | 105         | 64          | 39          | 28          |
| 4th                         | 145            | 95          | 58          | 31          | 27          |
| 3rd                         | 134            | 83          | 42          | 26          | 26          |
| 2nd                         | 96             | 80          | 35          | 23          | 25          |
| 1st                         | 55             | 50          | 29          | 17          | 24          |
| Age N                       | 547            | 100         | 125         | 241         | 42          |
| Mean                        | 21.43          | 35.52       | 44.00       | 47.65       | 52.98       |
| S.D.                        | 3.24           | 3.01        | 1.12        | 1.36        | 2.01        |
| Score (Maximum 240 seconds) |                |             |             |             |             |
| Mean                        | 226.70         | 220.33      | 205.95      | 190.29      | 181.00      |
| S.D.                        | 33.95          | 42.57       | 59.77       | 67.36       | 71.62       |

Table VI

SOLEC-R Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile                  | Age Categories |             |             |             |             |
|-----------------------------|----------------|-------------|-------------|-------------|-------------|
|                             | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                        | 150            | 150         | 150         | 150         | 150         |
| 95th                        | --             | --          | --          | --          | --          |
| 90th                        | --             | --          | --          | --          | 149         |
| 85th                        | --             | --          | --          | 149         | 131         |
| 80th                        | --             | --          | --          | 138         | 128         |
| 75th                        | --             | --          | --          | 127         | 114         |
| 70th                        | --             | --          | 149         | 124         | 111         |
| 65th                        | --             | --          | --          | 117         | 102         |
| 60th                        | 149            | 149         | 143         | 105         | 90          |
| 55th                        | --             | 148         | 145         | 87          | 79          |
| 50th                        | 148            | 147         | 135         | 77          | 69          |
| 45th                        | 146            | 140         | 128         | 71          | 58          |
| 40th                        | 141            | 128         | 115         | 65          | 55          |
| 35th                        | 133            | 112         | 106         | 49          | 49          |
| 30th                        | 129            | 100         | 72          | 43          | 44          |
| 25th                        | 124            | 91          | 65          | 37          | 40          |
| 20th                        | 115            | 78          | 56          | 34          | 33          |
| 15th                        | 95             | 62          | 45          | 30          | 29          |
| 10th                        | 75             | 37          | 39          | 27          | 24          |
| 5th                         | 54             | 31          | 22          | 23          | 17          |
| 4th                         | 50             | 30          | 20          | 22          | 16          |
| 3rd                         | 44             | 29          | 10          | 20          | --          |
| 2nd                         | 39             | --          | 17          | 18          | 15          |
| 1st                         | 34             | 27          | 15          | 11          | 14          |
| Age N                       | 488            | 85          | 36          | 105         | 35          |
| Mean                        | 21.25          | 35.71       | 43.75       | 47.83       | 53.14       |
| S. D.                       | 3.10           | 2.95        | 1.42        | 1.43        | 2.11        |
| Score (Maximum 150 seconds) |                |             |             |             |             |
| Mean                        | 129.87         | 118.39      | 110.53      | 83.91       | 76.77       |
| S. D.                       | 31.68          | 42.02       | 46.61       | 46.93       | 43.61       |

Table VII

SOLEC-L Test: Norms, Means, and Standard Deviations of  
Scores of Normal Men in Five Age Categories

| Percentile                  | Age Categories |             |             |             |             |
|-----------------------------|----------------|-------------|-------------|-------------|-------------|
|                             | 16-30<br>yr    | 31-40<br>yr | 41-45<br>yr | 46-50<br>yr | 51-60<br>yr |
| 99th                        | 150            | 150         | 150         | 150         | 150         |
| 95th                        | --             | --          | --          | --          | --          |
| 90th                        | --             | --          | --          | --          | 149         |
| 85th                        | --             | --          | --          | 149         | 137         |
| 80th                        | --             | --          | --          | 140         | 128         |
| 75th                        | --             | --          | --          | 129         | 123         |
| 70th                        | --             | 149         | 149         | 125         | 110         |
| 65th                        | --             | 148         | 148         | 118         | 101         |
| 60th                        | --             | 145         | 146         | 110         | 95          |
| 55th                        | --             | 139         | 141         | 97          | 74          |
| 50th                        | 149            | 130         | 138         | 84          | 70          |
| 45th                        | 148            | 127         | 133         | 71          | 67          |
| 40th                        | 142            | 123         | 125         | 57          | 60          |
| 35th                        | 133            | 114         | 101         | 52          | 56          |
| 30th                        | 127            | 100         | 85          | 48          | 45          |
| 25th                        | 122            | 91          | 65          | 42          | 41          |
| 20th                        | 113            | 68          | 53          | 38          | 38          |
| 15th                        | 98             | 60          | 41          | 34          | 34          |
| 10th                        | 78             | 44          | 22          | 27          | 29          |
| 5th                         | 56             | 37          | 19          | 22          | 17          |
| 4th                         | 53             | 35          | --          | 20          | 16          |
| 3rd                         | 42             | 34          | 18          | 18          | --          |
| 2nd                         | 31             | 31          | 12          | 16          | 15          |
| 1st                         | 24             | 22          | 10          | 13          | 14          |
| Age N                       | 488            | 85          | 36          | 105         | 35          |
| Mean                        | 21.25          | 35.71       | 43.75       | 47.83       | 53.14       |
| S.D.                        | 3.10           | 2.95        | 1.42        | 1.43        | 2.11        |
| Score (Maximum 150 seconds) |                |             |             |             |             |
| Mean                        | 130.12         | 115.55      | 109.56      | 86.17       | 80.26       |
| S.D.                        | 31.70          | 40.23       | 48.86       | 46.69       | 43.51       |

Table VIII

WO FEC Test: Norms, Mean, and Standard Deviation of  
Scores of Normal Men, Ages 17-61 Years

| Percentile               | Score |
|--------------------------|-------|
| 99th                     | 30    |
| 95th                     | 28.5  |
| 90th                     | 27.5  |
| 85th                     | 26.5  |
| 80th                     | 25.5  |
| 75th                     | 24.5  |
| 70th                     | 23.5  |
| 65th                     | 22.5  |
| 60th                     | 21.5  |
| 55th                     | 20.5  |
| 50th                     | 19.5  |
| 45th                     | 18.5  |
| 40th                     | 17.5  |
| 35th                     | 16.5  |
| 30th                     | 15.5  |
| 25th                     | 14.5  |
| 20th                     | 13.5  |
| 15th                     | 12.5  |
| 10th                     | 11.5  |
| 5th                      | 10.5  |
| 4th                      | 29    |
| 3rd                      | 27    |
| 2nd                      | 24    |
| 1st                      | 17    |
| Age N                    | 287   |
| Mean                     | 24.25 |
| S.D.                     | 8.73  |
| Score (Maximum 30 steps) |       |
| Mean                     | 29.74 |
| S.D.                     | 1.65  |

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